DEVICE FOR STACKING FLAT, FLEXIBLE OBJECTS

The invention relates to a device for stacking flat, flexible objects standing on their narrow edge in a stacking compartment in an upright position according to the preamble to Claim 1.

The flat objects to be stacked, e.g. letters, may vary quite considerably with regard to length, height and elasticity. They are conveyed in succession at minimal intervals, preferably pinched between elastic belts (cover band system). To prevent jamming caused by the front edges of the objects pushing against the rear edges of the objects in front during stacking, it is necessary to move the rear edges of the preceding objects out of the way of the front edges of the following objects. This is called "clearing the insertion channel".

In order to achieve this, a driven stacking spindle was described in DE 3 317 865 A1, said spindle being positioned immediately in front of each stacking compartment and with the rear portion of the objects being deflected at an ascending angle to the stack, so that the subsequent objects do not push against the rear edges of the previously stacked objects, but sideways on. The force transfer through the spindle is effected on the lower edge of the objects. However, this results in particularly tall objects being twisted due to mass inertia, i.e. the upper rear edge clears the "insertion channel" too late or not at all. Until now, it has only been possible to use stack spindles beneficially for objects with small differences in length. Their position is generally geared to the rear edge of the shortest object to be stacked. If the length ratio between the longest and the shortest object is greater than 2, their effectiveness in dealing with long objects is reduced still further.

Other diverting elements, e.g. pivoting levers such as switch vanes, have also been disclosed (US Re. 34,330 = US 34330 E). In this case the diverting element is implemented as a reverse flow current switch, i.e. in the non-diverted state the point is directed away from the pivot against the direction of movement of the objects. If the diverting element is not started up before it is reached by the front edge of an object, a frontal collision with the object occurs which may result in said object being destroyed.

To enable objects in a wide range of formats to be stacked accordingly, it was proposed – according to DE 101 18 758 C1 – that several diverting elements be arranged in series.

These solutions failed to take into account the fact that, especially with large ranges of

formats, there are always objects which – owing to their specific characteristics – bend into the insertion channel with their upper rear corner following successful stacking, and thus present a potential hazard for the subsequent object to be inserted. Further adverse effects are caused by the large number of collisions with the objects and the high relative speeds between object and diverting element.

The object of the invention, therefore, is to create a suitable device which, while handling the objects carefully, also ensures not only that the rear edges of the objects to be stacked are pushed out of the insertion channel, but also that the objects already successfully stacked are prevented from bending back into the insertion channel as a result of their flexibility.

According to the invention, this object is achieved by the features described in Claim 1.

Thus, to the side of a plane of conveyance for the path of the objects into the stacking compartment, one or more hook-shaped elements for diverting and supporting the rear portions – with regard to the direction of movement – of larger objects are placed one above the other in the direction of the stack support, and are fastened at one end to a shaft driven in a controlled manner. The distance of the inner contour of the free end of the hook-shaped elements from the plane of conveyance is greater than the thickest object and the distance of the outer contour of the free end from the plane of conveyance is large enough to enable the rear portions of large stacked objects in the plane of conveyance to be supported in order to keep the insertion channel clear. Also provided are sensors for detecting the front and rear edges of objects conveyed with preset speed, and means of evaluation for determining, from the sensor signals, the positions of the front and rear edges at specific points in time. A control element for controlling the drive of the shaft for the hook-shaped element(s) is configured in accordance with these time-variable positions, such that – when an object enters the stacking compartment – a sensor signal generated by the front edge of the incoming object is triggered, the hook-shaped element(s) is/are oriented in such a manner that the object enters the hook-shaped element(s) and, at the same time, the rear edges of the large objects in the stack are kept out of the insertion channel. The hook-shaped element is, in synchronization with the movement of the object, swung out from the plane of conveyance thus enabling the object to enter the stacking compartment without being obstructed. The distance of the hook-shaped element(s) from the abutment is so large that the supporting function remains effective

while the hook-shaped element is swung out until the front edge of the incoming object overlaps, to a defined extent, the rear edges of the supported objects that are already stacked. A sensor signal generated by one of the rear edges of the incoming object is triggered, and then the hook-shaped element is swung back into its initial position supporting the rear edges. The hook-shaped element therefore combines the functions of pushing out the rear edges of long, narrow objects, with a supporting function, which prevents particularly large, unstable objects from bending their upper rear corner back into the insertion channel following successful stacking.

Advantageous embodiments of the invention are explained in the subclaims.

In order that the supporting function is retained for as long as possible during the swinging movement of the hook-shaped element, it is advantageous for said hook-shaped element to have a component directed away from the center of rotation, to which component is attached a component having an almost circular, arc-shaped outer contour, the center of curvature of which lies in the center of rotation.

It is also advantageous for the number of hook-shaped elements and their distances from the base plate on the shaft to be selected such that all objects to be stacked with various heights can be supported.

In order that only minimal stresses are placed on the stacked objects by the hook-shaped elements, the parts of the hook-shaped elements that are in contact with the letters advantageously have a low coefficient of friction.

To ensure that shorter objects are stacked smoothly, it is advantageous for a stack spindle for shorter objects to be provided between the stack roll and the hook-shaped element(s).

The invention is now described in an exemplary embodiment with the help of drawings.

In the drawings,

FIG 1-3 show a schematic view of a stacking device in different phases of the stacking process, and

FIG 4 shows a cross-section from A-A.

The objects 3 are fed into the stacking compartment individually, pinched in belts 4 of a cover band system. The belt assigned to the stacking compartment of the cover band system is fed diagonally, not as far as the other belt, via deflection rollers 14 toward an abutment 11

of the stacking compartment, at which the flat objects 3 are stopped. This causes the objects 3 to be fed into the stacking compartment from one side only. A light barrier 5 for detecting the incoming objects 3 is located in the path of conveyance at the entrance to the stacking compartment. On the way to the abutment 11, the objects 3 pass hook-shaped elements 1 which are pivot-mounted one above the other, and which are fixed at one end to a shaft 13 driven in a controlled manner by a motor 9. This shaft 13 is disposed away from the stack 7 just behind the plane of conveyance, which is defined by the cover band system and a guide 12. This is followed by the cover band system deflection roller 14 situated closest to the abutment. A stacking roll 6 is then disposed in the path of conveyance.

Each object 3 is curved by the angle of the direction of conveyance into the stacking compartment in order to direct the stack around the stacking roll 6. As a result of the reduction in the bending stress, the rear edges of the objects 3 move crosswise to the direction of conveyance and out of the insertion channel. In order to support and accelerate this crosswise movement, a known stack spindle 8 is assigned to the side facing the stack 7 in front of the stacking roll 6. The rear edges of longer objects 3 that protrude well beyond the stack spindle 8 are additionally moved out of the insertion channel by the hook-shaped elements 1. In the starting position, the hook-shaped elements 1 are positioned such that an incoming object 3 moves into the open end of the hook-shaped element 1 (FIG 1).

In synchronization with the object 3 entering the stacking device, the hook-shaped elements 1 rotate in the direction of the arrow such that, in accordance with their selected geometrical form, they precede the front edge of the incoming object until they have completely "disappeared" behind the plane of conveyance (FIG 2). The hook-shaped elements 1 combine the functions of pushing out the rear edges of longer objects 3 with a supporting function which prevents – for example – large, unstable objects 3 from bending their free upper rear corners back into the insertion channel following successful stacking.

The geometric form of the hook-shaped elements 1 is such that their outer edges are like a circular segment, the central points of which are located at the pivot of the hook-shaped element 1. All curved elements attached thereto are tangentially rounded.

The surfaces with which the hook-shaped elements 1 come into contact with objects 3 to be stacked are designed with minimum friction characteristics with regard to the object material.

During the stacking process, the support function – provided by the outer contour of

the hook geometry – is retained for thin, large, unstable objects 3, until the front edge of the incoming objects 3 sufficiently overlaps the bending, stacked objects.

Once the object 3 to be stacked has been inserted sufficiently far into the stacking device, the hook-shaped elements 1 have become positioned such that the rear edges of the hook geometry move out of the plane of conveyance and thereby exert a constantly increasing transverse acceleration onto the rear edges of the object 3.

Depending on the characteristics, this section of the movement of the hook-shaped elements 1 may be effected with or against the direction of conveyance of the incoming object 3 (FIG 3 shows movement against the direction of conveyance), in which a hook-shaped element 1 rotating in the direction of conveyance has the advantage of low relative speed to the incoming object 3.

Once the hook-shaped elements 1 return to their starting position, they stop in this position and support the objects just stacked. The next process is then started again with the subsequent object 3.

The motion sequence of the hook-shaped elements 1 is controlled and monitored by a control device, which – depending on object information obtained during previous processes and on the signal from the light barrier 5 located in the immediate vicinity on the front edge of the item to be stacked - starts a corresponding procedure.